

Editorial

Welcome to the third TCCS newsletter!

The Texas Consortium for Computational Seismology is a joint initiative of the Bureau of Economic Geology (BEG) and the Institute for Computational Engineering and Science (ICES) at The University of Texas at Austin. Its mission is to address the most important and challenging research problems

TCCS Sponsors

TCCS appreciates the support of its sponsors: BP, Chevron, CGGVeritas, ConocoPhillips, ExxonMobil, Hess, Saudi Aramco, Schlumberger, Shell, Statoil, Total, and Z-Terra.

New Gold Sponsor

TCCS welcomes Shell as a new Gold Sponsor, supporting the focused project, *High-Resolution Seismic Attributes for Fracture*

Spring Meeting

The Spring 2013 Research Meeting of the Texas Consortium for Computational Seismology was held in Houston on March 25–26, at the BEG Houston Research Center. Nearly 70 people attended the meeting, including representatives from 12 sponsor companies. In addition to 17 research presentations by TCCS staff, guest lectures were given by Professors Jiubing Cheng (Tongji University), Loukas Kallivokas (UT Austin's Department of Civil Engineering), and William Symes (Rice University).

See you in Houston

TCCS submitted 19 expanded abstracts to the 2013 SEG Annual Meeting in Houston. The submitted papers fall into 10 different subject areas: Acquisition, Full Waveform Inversion, Rock Physics, Seismic

in computational geophysics as experienced by the energy industry, while educating the next generation of research geophysicists and computational scientists.

In the third issue of the TCCS newsletter, you will find the latest updates on our group's research highlights and professional awards, fall 2013 meeting announcement, the newest high-performance computing resource that we use, and new faces! We are looking

Characterization in Grosmont Formation.

Additionally, Statoil has extended its support of our program by extending a Ph.D. fellowship to Siwei Li and by awarding a new Ph.D. fellowship to Junzhe Sun. Junzhe's project is *Lowrank Reverse Time Migration for Subsalt Imaging.*

forward to your feedback, suggestions, and requests for sponsorship or research collaboration.

TCCS Advisory Committee

The TCCS Advisory Committee met in Austin on December 3, 2012, to develop new recommendations for the program. The committee included Bjorn Engquist, Sergey Fomel, Omar Ghattas, Stewart Levin (Stanford University), Karl Schleicher, William Symes (Rice University), and Lexing Ying. Among other recommendations, the committee recommended developing closer connections between TCCS and analogous programs at other universities, as well as exploring new hiring opportunities at UT Austin.

The meeting agenda is available at http://www.beg.utexas.edu/tccs/docs/2013_1_agenda.pdf.

Presentations and report materials from the meeting are available to sponsors in the members' area of the TCCS website: <http://www.beg.utexas.edu/tccs/private/index.php>

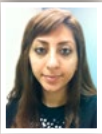
The Fall 2013 Research Meeting will tentatively be held in Austin, September 30–October 1, right after the SEG Annual Meeting.



Anisotropy, Seismic Interpretation, Seismic Modeling, Seismic Migration, Seismic Theory, Seismic Velocity Estimation, and Time-Lapse Seismic.



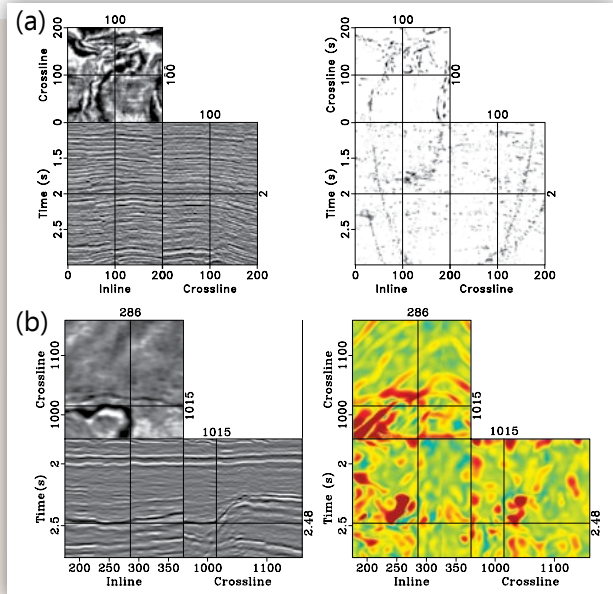
Research Highlights



Structural attributes from predictive painting

Predictive coherency, a fault-identifier attribute, has been developed by **Parvaneh Karimi**. This attribute uses predictive painting to form the structural prediction of seismic traces from their neighbors and is capable of identifying local changes in information across the fault and protecting them (a).

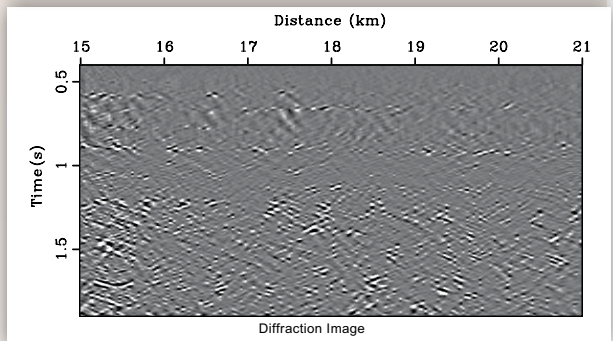
Parvaneh has also developed an approach to computing volumetric curvature, which employs predictive painting in computing reflector shapes (b).



Diffraction imaging, one dip at a time

Alexander Klovov is working on secondary migration of constant-dip partial images obtained after common-reflection-angle migration. This secondary migration produces seismic images

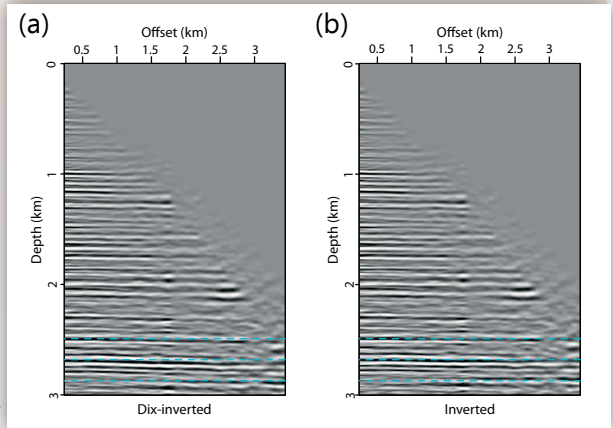
independently for every subsurface dip angle. The procedure allows collecting of migrated diffraction energy and enhancing of images of diffraction objects.



Robust time-to-depth conversion

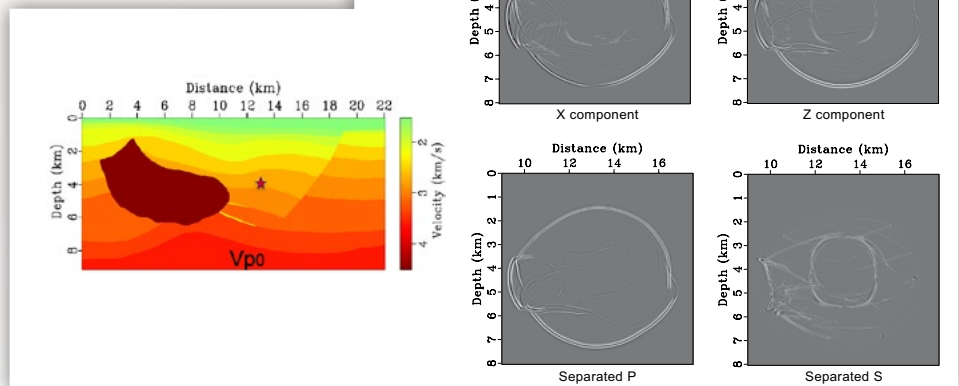
Siwei Li developed a novel approach to estimating seismic interval velocity from time-migration velocity. The figure shows common-image gathers after Kirchhoff depth migration with the prior and inverted

models. In deeper sections, the prior velocity tends to be too large, and the gather appears curving downward at large offsets. After time-to-depth conversion, the gather is flattened, indicating a correct velocity update.



Elastic-wave-mode decomposition

Jiubing Cheng, a visiting professor, has developed a fast, new mixed-domain algorithm for elastic-wave-mode separation and vector decomposition in heterogeneous, transversely isotropic media. The synthetic example of the Hess/VTI model demonstrates that, from coupled elastic wavefields, good mode separation and vector decomposition of qP waves, and qSV waves, can be obtained.



Professional Awards



Lexing Ying, a co-founder of TCCS and current Professor of Mathematics at Stanford University, has been awarded the 2013 James H. Wilkinson Prize in Numerical Analysis and Scientific Computing from the Society of Industrial and Applied Mathematics (SIAM). This prize is awarded every 4 years for research in numerical analysis and scientific computing during the 6 years preceding the award. The prize-selection committee recognized Lexing's contributions in "the design of fast and accurate numerical algorithms for fundamental problems in scientific computing." Bjorn Engquist, another of TCCS's co-founders, received the first Wilkinson Prize back in 1982. Lexing will accept his prize during the Annual SIAM Meeting in July.



TCCS alumnus Jack Poulson was awarded the Outstanding Dissertation Award

from UT Austin's Graduate School on the basis of the impact of his subject, the originality/creativity of his work, the quality of his scholarship and writing, and its potential for publishing. Jack's dissertation, *Fast Parallel Solution of Heterogeneous 3D Time-Harmonic Wave Equations*, was defended in December 2012 and addresses the problem of solving the high-frequency Helmholtz equation, which has direct applications in seismic imaging and full-waveform inversion. After 6 months of a postdoctoral fellowship at Stanford, Jack has accepted a faculty position at the Georgia Institute of Technology, School of Computational Science and Engineering.

In December 2012, Sergey Fomel received the Outstanding Educator Award from the Jackson School of Geosciences, UT Austin. The purpose of the award is to recognize outstanding accomplishments in any area that promotes the future success of students, staff, or other faculty and scientists through teaching,

mentoring, or supervision of undergraduate or graduate research. A citation by Sharon Mosher, the Dean of the Jackson School, says "Sergey is an enthusiastic scientist who attracts young geophysicists to the field of applied data analysis. He is a superb educator in many important ways: in the classroom as a lecturer, in private as an advisor to the large number of M.S. and Ph.D. students and post doctoral scientists who flock to him, and to other researchers both internally and externally."



Sergey Fomel's paper, "Seismic data decomposition into spectral components using regularized

nonstationary autoregression", presented at the 2012 SEG Annual Meeting in Las Vegas, was included on the Top 30 SEG Presentations list. On May 6, Sergey presented this paper in the "Best of SEG" session at the GeoConvention in Calgary.

Stampede

The Texas Advanced Computing Center has unleashed Stampede, one of the largest computing systems in the world for open scientific research. According to the [November 2012 Top 500 List of Supercomputers](#), Stampede is currently the seventh-most powerful advanced computing system in the world and the most powerful in the U.S. dedicated to academic research.

On March 27, leaders from government, academic and industry—including UT Austin's President Bill Powers; Jay Boisseau, Director of TACC; Marius Haas, President of Enterprise Solutions at Dell; Diane Bryant, Senior Vice President & General Manager, Datacenter & Connected Systems

Group at Intel; Farnam Jahanian, Assistant Director of Computer & Information Science and Engineering Directorate at NSF; and U.S. Congressman Lamar Smith—dedicated Stampede and kicked off a new era of advanced computing at the university and nationally.

Stampede has 6,400 nodes with 102,400 processing cores, 205 terabytes of total memory, and more than 9 petaflops of peak performance. The system components are connected via a fat-tree, FDR InfiniBand inter-connect. A total of 160 computer racks house compute nodes with dual, eight-core sockets and feature the new Intel Xeon Phi coprocessors. Additional racks house login,



I/O, big-memory, and general hardware-management nodes. Each compute node is provided with local storage. A high-speed Lustre file system is backed by 76 I/O servers. Stampede additionally contains 16 large memory nodes, each with 1 TB of RAM and 32 cores, and 128 standard compute nodes, each with an NVIDIA Kepler K20 GPU. The cluster resource manager for job submission and scheduling is SLURM (Simple Linux Utility for Resource Management).

TCCS Staff

The TCCS family consists of people from eight different countries who have come together to move science forward. Our research staff includes principal investigators, postdocs, Ph.D. students, M.S. students, B.S. Honor students, and a senior research fellow:

Vladimir Bashkardin (Ph.D. 6th-year)
Lubna Barghouty (B.S. Honors)
Yangkang Chen (Ph.D. 1st-year)
Luke Decker (M.S. 1st year)
Björn Engquist (PI)
Mehdi Far (Postdoc)
Sergey Fomel (PI)
Shaunak Ghosh (M.S. 2nd year)
Jingwei Hu (Postdoc)
Parvaneh Karimi (Ph.D. 3rd year)
Alexander Klokov (Postdoc)

Pictures from the TCCS spring picnic.



Siwei Li (Ph.D. 4th-year)
Karl Schleicher (Senior Research Fellow)
Yanadet Sripanich (B.S. Honors)
Junzhe Sun (Ph.D.-1st year)

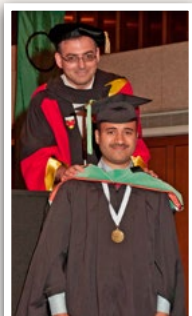
For more information,
see <http://www.beg.utexas.edu/tccs/staff.php>.



Testimonials

Jiubing Chen: "TCCS is a young research group full of imagination and vitality, in which the outstanding geophysicists and applied mathematicians, and creative and diligent students make their contributions to solve very challenging theoretical and practical problems for seismic exploration. I really appreciate and enjoy the philosophy of reproducible research promoted by Sergey. As a visitor, I found my interaction with TCCS members to be both delightful and rewarding. I am so lucky that TCCS let me have a wonderful experience at UT Austin."

Jack Poulson: "I was lucky enough to begin participating in TCCS in March of 2011 and have greatly enjoyed the rich interplay between industrial and academic interests. I look forward to attending the future meetings!"



Salah A. Al-Hadab: "My experience at TCCS was memorable, challenging, and very rich in all aspects. The wealth of information was tremendous, and people are

outstanding. The unlimited resources and advanced facilities are major factors for our success and productive research. I think having the Texas Advanced Computing Center (TACC) is a big plus. TACC allows us as students to run large-scale numerical experiments. I truly enjoyed my time at TCCS learning and being challenged."

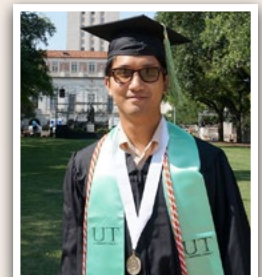
New Faces



Mehdi E. Far, a new postdoc with EGL and TCCS, received his B.Sc. in Petroleum Engineering from the Petroleum

University of Iran in 2001. His M.Sc. in Geosciences is from IFP School, Paris, France, in 2008, and his Ph.D. in Geophysics is from the University of Houston in 2011. His research interests include seismic anisotropy, fracture modeling, multicomponent seismic, AVO, AVAZ, seismic inversion, image processing, and pattern recognition.

Before studying abroad, **Yanadet Sripanich** graduated from Triam Udon Suksa School in Bangkok,



Thailand. He is one of the Royal Thai Scholars (2008) who earned a full scholarship from the Royal Thai Government to study Geosciences in the USA. He enrolled at The University of Texas at Austin in the Fall of 2009. He was also a part of the undergraduate Honors Research Program of the Jackson School of Geosciences. His honor project, supervised by Sergey Fomel, focused on efficient algorithms for seismic ray tracing in layered media and their application in exploration geophysics. In May 2013, Yanadet graduated with highest honors in both Geophysics and Mathematical Sciences and was valedictorian of the Jackson School of Geosciences. He will be continuing his work at TCCS as a Ph.D. student starting in the Fall of 2013.